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Impact of Factors Hindering Inland Waterways Operational Costs in Nigeria: A Case Study of Lagos State Waterways

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Abstract **Review Article**

Transport demand is a derived desire, and it is the objective that all forms of transportation, particularly inland waterways, share, regardless of how beneficial they are for economic growth and efficient methods of transportation. The study attempts to undertake a thorough analysis of inland waterways operating costs as well as passenger mobility expenses in Lagos State, despite the fact that inland waterways transport operating costs have an impact on the performance of the ferry service.

The Marina Terminal, Mile II Ferry ports, Ipakodo Terminal, and Falomo Terminal are the four specific ferry ports in the city of Lagos that were the focus of this investigation. The daily users of all seven Lagos State waterway terminals make up the sampling frame. These ports handle ferries that run on Lagos waterways every day, including 30 passenger monohulls and 40 passenger catamaran ferries. A number of cost-related elements that affect productivity and profitability have a direct impact on Ferry operations. Poor infrastructure and inappropriate dredging of rivers are major obstacles that raise fuel consumption, maintenance expenses, and delays. The study came to the conclusion that maintaining a balance between cost control and service quality is essential to the viability of ferry operations.

Through improved regulations, infrastructural development, and technological improvements, these cost-hindering variables can be reduced, making ferry services more dependable, affordable, and available to both enterprises and passengers. In order to enhance the quantity of traffic generated, it was suggested that the government subsidize the freight price and create a policy that would require the use of the ferry service.

Keywords: Operational costs, Dredging, Profitability, Sustainability, Fuel consumption.

1. INTRODUCTION

Transport demand is a derived demand, and it is the objective that all forms of transportation, particularly inland water transportation, share, regardless of its benefits for economic growth and efficient means of transportation. It serves to promote mobility by cutting down on users' waiting and travel times compared to road transportation. Additionally, efficient water transportation lowers operating costs more than any other mode of transportation because it takes the correct route, which lowers costs and travel time, whereas other modes of transportation take the incorrect route while attempting to get around any obstacles, which raises costs.

Numerous studies have estimated various perspectives on the transport operating cost in Lagos State, including those by Udechukwu and Mobolaji (2020), Babatunde (2020), Abdulkadir and Halimat (2020), and Hart et al. (2020). There is a dearth of study that focuses only on the operational costs of inland waterways in Lagos State, despite the fact that these costs have an impact on the ferry service's performance. By thoroughly analyzing the operational expenses of inland waterways and the mobility costs of passengers in the study area, as well as determining the socioeconomic characteristics and the correlation between ferry commuters' income and ferry operating costs, this study closed the gap. In order to reduce traffic and increase mobility, Lagos State, a coastal city with a vast network of lagoons, creeks, and rivers, heavily depends on inland waterways transit (IWT). However, a number of variables, like as infrastructure, fuel pricing, security, and maintenance, affect how much it costs to run water transportation in Lagos.

Since the majority of the structure and significance of terminals are regarded as "priceless," no money should be spared in their design, construction, refurbishment, or upkeep. Terminals are the most prestigious buildings and architectural commissions of our time. They are quickly taking on a function in the

community that is comparable to that of retail centers or parks, and they provide solutions for trade and movement throughout Lagos State. The preservation, upkeep, and marketing of terminals' constantly rising demands have been the key problems, particularly in Lagos State's Ikorodu and Marina neighborhoods. Increased investment in inland water transport infrastructure is necessary to support and maintain the socioeconomic activities between the suburbs and the central business district of Lagos. This will significantly alleviate traffic congestion in Lagos and its neighboring states, necessitating attention to inland waterway operation and terminal construction. Given Lagos State, Nigeria's expanding population, it is important to take note of the reasons preventing inland waterways from operating at a profit.

2. LITERATURE

Moro, Calacci, Dong, and Pentland (2021) claim that transit is a derived need that results from the need to interact and is a gauge of the level of communication between locations. People and products can be transported in a variety of methods, such as by pipeline, rail, air, sea, and land (Nwafor and Onya, 2019). A few basic elements are also present in transportation, regardless of its shape or level of operation (Iclodean, Cordos, and Varga, 2020). These elements consist of "vehicles" such as cars, buses, and airplanes; "terminals" such as bus stops and train stations; and "energy," which serves as the vehicle's source of propulsion. These "ways" include things like roads, water, steel lines, etc.

For instance, inland water transportation in Lagos makes it possible for residents to relocate to more hospitable and appealing areas where their needs may be met. There is a constant need for spatial connection between the island and other areas of Lagos because of the city's large population, high level of urbanization, and industrialization, which provide more options. Through spatial interaction made possible by the use of transportation systems and modes to reach the locations where needs can be met or services made available, complementarities allow corresponding supply. Conversely, supplies of goods are transported to reach their respective destinations. In maritime nations, traveling by water was once a common way to get across the interior. It was a fantastic system for transporting a lot of commodities and people across a considerable distance, both inside inland regions and between island towns as well as over wider seaways. The sizes, lengths, and courses of the older canals had to be extended as the population grew and the amount of cargo that needed to be transported increased.

In order to create comprehensive inland waterway networks, humans started constructing canals and enhancing rivers. In addition to being a significant part of the rural and urban landscapes of south-west and south-south Nigeria, inland waterways also contribute significantly to people's quality of life and are regions rich in biodiversity and cultural heritage. Through construction and the supply of recreational amenities, it also encourages economic revitalization. When there are plenty of navigable rivers and canals but not enough good or accessible roads or railroads, it is a very effective way to move liquid, heavy, or large freight (Trivedi, Jakhar, and Sinha, 2021).

Using the term "transportation," Fischer, Scholten, and Unwin (2019) later stressed the concept of locations of differential placement in space and the necessity of connectedness between them. Adesanya (2023) claims that a visit to a few airports in Lagos State showed a conspicuous shortage of security personnel in the evenings, a sign of the governments' incapacity to maintain control and enforce adherence to safety rules. Purchasing vessels that can manage high traffic volumes is also crucial for the transportation sector of inland waterways. Reducing heavy traffic on Lagos State's main roads and meeting commuters' journey habits depend on an efficient, sustainable ferry service (Oloye and Oloruntoba, 2022). These terminals' egregious flaws have been impeding their efficacy and failing to provide the flexibility and convenience that are sorely needed to foster a welcoming atmosphere for commuters' mobility as well as that of products and services. This study will examine the variables preventing ferry operation costs in Lagos State in light of the aforementioned.

The three essential components of any network or graph are its nodes, or vertices; its links, or edges; and its sub-graphs, or independent or disconnected portions, according to Mata (2020), who described a network as a system of communication that man constructed. Roads are represented by the links, and settlements by the nodes. By converting the network into a typological graph or map a type of geometry that is associated with the locations and connections between points and lines it is reduced to its most basic form. Because inland canal transport can carry big freight at a lower cost, it reduces the pressure and congestion that other modes of transportation, such as rail, road, and air, and their infrastructure, would have otherwise experienced. Ferry services from Mile II in Lagos to Apapa and/or to CMS, for instance, reduce traffic jams on the roads and slow down economic activity. They also serve as an inexpensive and energy-efficient alternative to other modes of transportation, lowering transportation costs and providing a dependable and affordable alternative to other modes of transportation (Bamwesigye and Hlavackova, 2019).

According to the State Waterways Authority, boat owners in Lagos State who neglect to supply life jackets for their passengers face legal action (Abiodun, 2021). Another organization tasked with ensuring a successful public transportation system that aids in the fight against poverty, offers economic opportunities, and fosters thriving communities within the Lagos metropolitan area is the Lagos Metropolitan Transport Authority (LAMATA). Through the bus rapid transit system, road transportation has recently improved somewhat, but the two modes cannot be seamlessly connected (Onokala and Olajide, 2020).

Since the LASWA act was introduced in 2008, the State government has also implemented a number of projects to support the waterways transportation systems. These include the Ijegun-Egba jetty, the Ebute-Ojo ferry terminal, the Badore ferry terminal, the Mile-II ferry terminal, the Osborne ferry terminal, and the Ikorodu ferry terminal. The jetties and terminals include a number of amenities, including floor areas, parking lots, bus parks, fuel dumps, walkways, retail establishments (restaurants, shops, banking halls, etc.), and

accessibility for people with disabilities. Additionally, the Ijegun and Ebute-Ojo jetties have a water treatment facility (Abiodun, 2021).

The operational features and availability of inland waterway transportation services in the coastal region of Anambra State, Nigeria, were examined by Udechukwu and Mobolaji (2020). According to the study, the majority of the vessels utilized were mid-sized wooden boats, and private ownership controlled the supply. On market days, profitable routes were used. Additionally, it was shown that the most important element influencing the supply of IWT services is demand. According to the study, in order to make IWT more appealing, operators should enhance the services they provide, and in order to improve the supply pattern, the current routes should increase traffic outside of market days. Additionally, it was suggested that boat owners look into using their vessels for purposes other than market days.

The assessment of ferry accidents on navigable rivers in a Nigerian urbanized city was examined by Chiamaka et al. in 2020. Spearman's rhyme The degree of association between the nature of ferry accidents and the state of navigable waterways was ascertained by correlation. According to the study, environmental factors are the main cause of ferry accidents in the studied area. The worst weather conditions, which included stormy weather and fog-induced poor visibility, received the highest rating score. Given the operator's poor maintenance culture, mechanical factors also played a role in the boat tragedy. The results also revealed that ferry services confront a number of difficulties, such as a lack of funds to buy the required navigational aids, deteriorating navigable waterways, and user attitudes toward transportation laws and regulations.

Therefore, the study suggests that the required measures be taken to safeguard the marine environment, prioritize safety, and optimize the inherent advantages of ferry operations and services.

3. METHODOLOGY

The Marina Terminal, Mile II Ferry ports, Ipakodo Terminal, and Falomo Terminal are the four specific ferry ports in the city of Lagos that were focused for this investigation. These ports handle ferries that run on Lagos waterways every day, including 30 passenger monohulls and 40 passenger catamaran ferries. Additionally, over 2,360 people made use of all seven major terminals within Lagos. Due to their high level of patronage, 863 passengers were purposefully selected from the four waterways ports out of the seven waterways terminals, and the population was sampled using the snowballing sampling approach. The research employed primary data source, using both Frequency distribution and Relative Important Index procedures which were employed as part of the statistical analysis method.

Relative Important Index Model

$$R.I.I. = \frac{(5n_1 + 4n_2 + 3n_3 + 2n_4 + n_5)}{5N} \quad (1)$$

$$0 \leq (R.I.I.) \geq 1$$

where:

n_1 = $Number of Respondent for$ strongly agreed

n_2 = $Number of repondent for$ agreed

n_3 = $Number of respondent for$ undecided

n_4 = $Number of respondent for$ disagreed

n_5 = $Number of respondent for$ strongly disagreed

The relative importance range was employed to determine the respondents' overall view of the significance of the problems. Livesey (2016) utilized it to make decisions regarding the problems he ranked. They are;

0.8 to 1.0= Very Significance

0.6 to< 0.8= Significance

0.4 to< 0.6= Neutral

0.2 to< 0.4= Little Significance

0.0 to< 0.2= Very Little Signicance

TABLE 1: Determination of numbers of respondents to select.

NAME OF TERMINAL	AVERAGE NO OF PASSENGER PER DAY	Respondent to be selected	Percentage 100%
Ebute Ojo – Ijegun Egba - CMS/Marina	280	176	20
Badore - Victoria Island - Falomo, Ikoyi	320	204	24
Ikorodu – Ebute - Ero - CMS/Marina	400	254	29.4
Miles II – Liverpool - CMS/Marina	360	229	26.5
Total	1360	863	100

Source: Author's Computation, 2025.

4. RESULTS AND DISCUSSION

818 respondents' demographic information is shown in table 2 according to their job status, employment experience, academic standing, and car ownership. Regarding educational background, the majority of responders had a degree or HND (35.7%), with diploma holders coming in second (30.2%). 12.6% have earned a master's degree, while a smaller percentage have only completed primary (7.6%) or secondary (13.9%) education. This implies that the majority of the people

in the sample have completed at least a diploma program. The largest group of responders (39%), in terms of job experience, had between 11 and 15 years of experience. Roughly equal percentages of people have 1–5 years (14.5%), 6–10 years (14.7%), and 16–20 years (14.9%) of experience; however fewer people have 21–30 years (6.8%) or more than 30 years (10%). With a noticeable concentration in the mid-career range, the data shows a balanced distribution of early-career, mid-career, and experienced professionals.

Regarding employment position, 30.7% of respondents are traders, while 40% are employed in military and paramilitary capacities. Entrepreneurs and freelancers are probably included in the category of "Others" (18.3%) for other respondents. The smallest percentage, 3.8%, is made up of civil servants, while 7.2% are students. This distribution shows how prevalent company owners and security guards are in the dataset.

Regarding car ownership, 36.1% of respondents do not possess a vehicle, compared to 63.9% who do. The majority of car owners (94.6%) only own one vehicle, compared to 4.4% who own two and 1% who own three. This implies that although owning a vehicle is popular, owning several vehicles is rather uncommon. Overall, the information shows a well-educated, mid-career workforce that is heavily represented in the business and security sectors. The majority of the workers also own personal vehicles.

Table 2: Socio-Economic Characteristics of the Respondents

Variable	Frequency	Percentage
Academic Status		
Primary	62	7.6
Secondary	114	13.9
Diploma	247	30.2
Degree/HND	292	35.7
M.Sc	103	12.6
Total	818	100
Work Experience		
1-5yrs	119	14.5
6-10yrs	120	14.7
11-15yrs	319	39.0
16-20yrs	122	14.9
21-30yrs	56	6.8
Above 30yrs	82	10
Total	818	100
Career Status		
Students	59	7.2
Civil Servants	31	3.8
Military and para-military	327	40
Traders	251	30.7
Others	150	18.3
Total	818	100
Vehicle Ownership		
Yes	523	63.9
No	295	36.1
Number of Vehicle		
1	279	94.6
2	13	4.4
3	3	1.0

Source: Field Survey, 2025.

Relationship between Ferry Operations and Factors Hindering Ferry Operating Cost

The Relative Importance Index (RII) is used to rate the factors that affect ferry operations in table 3. Greater significance in influencing operating costs is indicated by higher RII values. With a RII of 0.763, inappropriate dredging of rivers is the most significant issue. Ferries with poorly maintained channels use more fuel, run the danger of grounding, and require more frequent maintenance. Poor infrastructure is in second place with a RII of 0.762, emphasizing problems including antiquated passenger terminals, inadequate jet tie maintenance, and inadequate docking facilities, all of which lead to inefficiencies and delays in ferry services. Another significant issue is repair expenses, which rank third with a RII of 0.757. This is because ferry fleets frequently need repairs because to environmental wear and tear and inadequate waterway management. Insecurity, which ranks fourth with a RII of 0.747, has an additional impact on operations by raising insurance premiums and eroding

passenger trust in boat travel. In addition to increasing operating expenses, risks including theft, vandalism, and piracy discourage investment in the industry.

With a RII of 0.746, cleaning and personnel overheads raise expenses by paying employees and meeting ongoing sanitary needs. Waterway logs, which rank sixth with a RII of 0.703, can make operations less efficient by damaging engines and necessitating more navigational work to avoid obstacles. With a RII of 0.698, gasoline expenses have a big influence, particularly when fuel prices are fluctuating. By investing in fuel-efficient vessels and streamlining ferry routes, operators can mitigate this cost to some extent. With a RII of 0.691, a jetty due is the factor with the lowest ranking. Even though these fees add to the total cost, they pale in comparison to expenditures like infrastructure and upkeep. These fees are passed on to passengers by some operators, which lessens their significance in ferry operations.

Regular dredging is important to maintain waterway depth and enhance navigability while lowering needless fuel usage and mechanical damage in order to address these cost considerations. Modern ferry terminals and docking facilities are examples of improved infrastructure that can reduce delays and increase efficiency. Long-term maintenance and fuel expenses can be reduced via fleet modifications, such as the acquisition of sturdy and fuel-efficient ships. Enhancements in security, such as monitoring systems and more stringent enforcement tactics, can reduce dangers and promote more ridership. Additionally, scheduling efficiency can be increased while fuel consumption is decreased by optimizing routes with GPS and real-time monitoring technologies. Ferry operators may drastically reduce expenses and increase service dependability by putting these strategies into practice.

Table 3: Relationship between ferry operations and factors hindering ferry operating cost

S/N	Factors hindering operating cost	n_1	n_2	n_3	n_4	n_5	N	R.I.I	Rank
	Insecurity	14	154	639	1,292	955	3054	0.747	4
	Fueling	47	230	660	1044	875	2856	0.698	7
	Jetty dues	56	278	504	1,152	840	2830	0.691	8
	Repair	40	196	492	836	1535	3099	0.757	3
	Cleaning & Personnel Overhead	27	294	369	948	920	3058	0.746	5
	Log of wood of the water ways	41	210	690	1080	855	2876	0.703	6
	Poor infrastructure	30	190	480	1000	1415	3115	0.762	2
	Improper dredging of water ways channel	20	220	405	1160	1315	3120	0.763	1

Source: Author's Computation, 2025.

1.5 SUMMARY

A number of cost-related elements that affect productivity and profitability have a direct impact on Ferry operations in Nigeria most especially in Lagos. Poor infrastructure and inappropriate dredging of rivers are also major obstacles that raise fuel consumption, maintenance expenses in Inland transportation operations in Nigeria and causes increase to fare structures as well as delays in transportation of both passengers and freight. Frequent vessel failures and safety concerns increase insurance and security costs, while costs of repairing craft and instability along the waterways in Nigeria put further burden on its Inland waterways operations. Inland waterways operational difficulties are also increased by other elements including cleaning, employee salaries, floating trash, and gasoline costs. Even while jetty dues increased, they pale in comparison to other expenditures within the Inland waterways terminals. By tackling these issues with better dredging, infrastructure growth, fleet modernization, security improvements, and route optimization, Inland waterways transport services may become more sustainable by increasing efficiency and lowering waterways operating costs in Nigeria.

The study came to the conclusion that although a number of variables lead to high operational costs, the most important ones for Inland waterways transport services are inadequate dredging, inadequate infrastructure, and excessive maintenance costs. In addition to raising direct expenses, these problems also result in delays, erode passenger trust, and restrict the general dependability of Inland transport service. In the end, maintaining a balance between cost control and service quality is essential to the viability and accessibility of Inland waterways operations. Through improved regulations, infrastructural development, and technological improvements in all waterways terminal, these cost-hindering variables can be reduced, making Inland waterways transport services more dependable, affordable, and available to both enterprises and passengers. It was recommended that in order to boost the volume of traffic created along inland waterways in Nigeria most especially Lagos State; the government should subsidize the freight price and develop a policy that will enforce the use of Inland waterways transport services within the metropolis.

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